

**Amendments to the Claims:**

1. (currently amended) An image segmentation method, said method comprising:
  - a) obtaining pixel attribute data for a mixed-content image;
  - b) identifying a text region in said image;
  - c) identifying a background region in said image, wherein said identifying comprises
    - i) calculating a luminance histogram for said image,
    - ii) identifying a histogram bin containing a maximum number of values,
    - iii) comparing said maximum number of values to a threshold value, and
    - iv) classifying a pixel as background if said pixel corresponds to said histogram bin and said maximum number of values is greater than said threshold value;
  - d) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions, wherein said analyzing comprises:
    - i) calculating an area luminance histogram for said areas not classified as background or text,
    - ii) determining a number of populated histogram bins whose pixel count exceeds a threshold value,
    - iii) comparing said number of populated histogram bins to a bin number threshold value,
    - iv) classifying said area as a contone region when said number of populated histogram bins exceeds said bin number threshold value;
  - e) analyzing said contone regions to identify any text regions present within said contone regions;
  - f) analyzing said contone regions to identify any background regions present in said contone regions;
  - g) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions; and
  - h) repeating steps e-g until no further sub-regions are found.

2. (currently amended) ~~An image segmentation~~ The method as described in claim 1  
further comprising analyzing said contone regions and said contone sub-  
regions to identify pictorial contone regions.
3. (currently amended) ~~An image segmentation~~ The method as described in claim 1  
further comprising progressively expanding said background region beyond  
said initial maximum histogram bin into neighboring histogram bins when  
said neighboring histogram bins contain a sufficient number of pixels filtering  
said pixel data to remove noise.
4. (currently amended) ~~An image segmentation~~ The method as described in claim 1  
further comprising morphological processing of any of said text regions and  
any of said background regions to eliminate small isolated regions.
5. (currently amended) ~~An image segmentation~~ The method as described in claim 1  
further comprising removing any contone regions whose area is smaller than  
one tenth of the square of the page width ~~connected component labeling.~~
6. (currently amended) ~~An image segmentation~~ The method as described in claim 1  
further comprising analyzing said contone regions and said contone sub-  
regions to identify pictorial contone regions and non-pictorial contone regions,  
wherein said analyzing to identify pictorial contone regions comprises  
eliminating the two histogram bins containing the highest number of pixels  
and analyzing the remaining bins for bi-modal distribution ~~computing a~~  
~~bounding box for a region.~~

7. An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local feature to identify a text region in said image;
  - e) analyzing a luminance histogram of said image to identify a background region in said image, wherein said analyzing comprises
    - i) calculating a luminance histogram for said image,
    - ii) identifying a luminance histogram bin containing a maximum number of values,
    - iii) comparing said maximum number of values to a threshold value, and
    - iv) classifying a pixel as background if said pixel corresponds to said histogram bin and said maximum number of values is greater than said threshold value;
  - ~~f) labeling any background regions as such;~~
  - ~~g) applying morphological processing to said background regions and said text regions;~~
  - h) analyzing a chrominance histogram of said image to verify a background region in said image, wherein said analyzing comprises
    - i) calculating a chrominance histogram for said image,
    - ii) identifying a chrominance histogram bin containing a maximum number of values,
    - iii) comparing said chrominance histogram bin to said luminance histogram bin, and
    - iv) removing a pixel from a background classification if said chrominance histogram bin and said luminance bin are not substantially similar;
  - i) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - j) analyzing said contone regions to identify any text regions present within said

contone regions;

- k) analyzing said contone regions to identify any background regions present in said contone regions;
- l) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
- m) repeating steps e-g until no further sub-regions are found; and
- n) analyzing said contone regions and said contone sub-regions to identify pictorial contone regions.

8. (canceled)

9. (canceled)

10. (currently amended) An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local ~~discriminating~~-feature to identify a text region in said image;
  - e) analyzing a luminance histogram of said image to identify a background region in said image;
  - f) labeling any background regions as such;
  - g) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - h) analyzing said contone regions to identify any text regions present within said contone regions;
  - i) analyzing said contone regions to identify any background regions present in said contone regions;
  - j) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
  - k) repeating steps e-g until no further sub-regions are found; and
  - l) analyzing said contone regions and said contone sub-regions to identify contone regions and non-contone regions.
11. (currently amended) ~~An image segmentation~~ The method as described in claim 10 wherein said local ~~discriminating~~ feature is a standard deviation.
12. (currently amended) ~~An image segmentation~~ The method as described in claim 10 wherein said local ~~discriminating~~-feature is spread.

13. An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local ~~discriminating~~ feature, selected from the group consisting of standard deviation and spread, to identify a text region in said image, wherein a region is identified as text when said feature is above a local feature threshold value;
  - e) analyzing a luminance histogram of said image to identify a background region in said image, wherein a region is identified as background when an initial maximum histogram bin containing the highest number of pixels exceeds a background threshold value;
  - f) verifying said background region analysis using ~~region~~ chrominance histogram data;
  - g) labeling any background regions as such;
  - h) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - i) analyzing said contone regions to identify text regions present within said contone regions;
  - j) analyzing said contone regions to identify background regions present in said contone regions;
  - k) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
  - l) repeating steps e-g until no further sub-regions are found; and
  - m) analyzing said contone regions and said contone sub-regions to identify pictorial contone regions and non-pictorial contone regions.
14. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said local ~~discriminating~~ feature is standard deviation and said local feature threshold value is 32.
15. (currently amended) ~~An image segmentation~~ The method as described in claim 13

wherein said background threshold value is related to an image size.

16. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said background threshold value is 12.5% of image size.
17. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said identification of a the background region is independent of image element color.
18. (canceled)
19. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said identification of a background region further comprises the use of a chroma foreground mask and a hue foreground mask.
20. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said identification of contone regions comprises analyzing luminance histogram bins to determine the number of bins ( $N_{pop}$ ) containing more pixels than a contone threshold value, wherein a the region is considered a contone region when  $N_{pop}$  exceeds a uniformity threshold value.
21. (currently amended) ~~An image segmentation~~ The method as described in claim 13 wherein said analysis to identify contone regions comprises verification using region properties.
22. (currently amended) ~~An image segmentation~~ The method as described in claim 21 wherein said region properties comprise area.
23. (canceled)
24. (canceled).

25. (currently amended) An image segmentation apparatus, said apparatus comprising:
- a) a reader for obtaining pixel attribute data for a mixed-content image;
  - b) a text identifier for identifying a text region in said image;
  - c) a background identifier for identifying a background region in said image,  
said background analyzer comprising,
    - i) a calculator for calculating a luminance histogram for said image,
    - ii) an identifier for identifying a histogram bin containing a maximum number of values, and
    - iii) a classifier for classifying a pixel as background if said pixel corresponds to said histogram bin and said maximum number of values is greater than a threshold value;
  - d) a contone analyzer for analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions, said contone analyzer comprising;
    - i) a calculator for calculating an area luminance histogram for said areas not classified as background or text,
    - ii) a determiner for determining a number of populated histogram bins whose pixel count exceeds a threshold value, and
    - iii) a classifier for classifying said area as a contone region when said number of populated histogram bins exceeds a bin number threshold value;
  - e) wherein said text analyzer may analyze said contone regions to identify any text regions present within said contone regions;
  - f) wherein said background analyzer may analyze said contone regions to identify any background regions present in said contone regions;
  - g) wherein said contone analyzer may analyze areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions; and
  - h) wherein said text analyzer, said background analyzer and said contone analyzer may operate recursively on regions and sub-regions to identify nested regional attributes.



26. (currently amended) A computer-readable medium comprising computer-executable instructions for:
- a) obtaining pixel attribute data for a mixed-content image;
  - b) identifying a text region in said image;
  - c) identifying a background region in said image, said identifying comprising,
    - i) calculating a luminance histogram for said image,
    - ii) identifying a histogram bin containing a maximum number of values,
    - iii) comparing said maximum number of values to a threshold value, and
    - iv) classifying a pixel as background if said pixel corresponds to said histogram bin and said maximum number of values is greater than said threshold value;
  - d) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions, said analyzing comprising,
    - i) calculating an area luminance histogram for said areas not classified as background or text,
    - ii) determining a number of populated histogram bins whose pixel count exceeds a threshold value,
    - iii) comparing said number of populated histogram bins to a bin number threshold value,
    - iv) classifying said area as a contone region when said number of populated histogram bins exceeds said bin number threshold value;
  - e) analyzing said contone regions to identify any text regions present within said contone regions;
  - f) analyzing said contone regions to identify any background regions present in said contone regions;
  - g) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions; and
  - h) repeating steps e-g until no further sub-regions are found.

27. (new) An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local discriminating feature, selected from the group consisting of standard deviation and spread, to identify a text region in said image, wherein a region is identified as text when said feature is above a local feature threshold value;
  - e) analyzing a luminance histogram of said image to identify a background region in said image, wherein a region is identified as background when an initial maximum histogram bin containing the highest number of pixels exceeds a background threshold value;
  - f) progressively expanding said background region beyond said initial maximum histogram bin into neighboring histogram bins when said neighboring histogram bins contain a sufficient number of pixels;
  - g) verifying said background region analysis using region chrominance data;
  - h) labeling any background regions as such;
  - i) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - j) analyzing said contone regions to identify text regions present within said contone regions;
  - k) analyzing said contone regions to identify background regions present in said contone regions;
  - l) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
  - m) repeating steps e-g until no further sub-regions are found; and
  - n) analyzing said contone regions and said contone sub-regions to identify pictorial contone regions and non-pictorial contone regions.

28. (new) An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local discriminating feature, selected from the group consisting of standard deviation and spread, to identify a text region in said image, wherein a region is identified as text when said feature is above a local feature threshold value;
  - e) analyzing a luminance histogram of said image to identify a background region in said image, wherein a region is identified as background when an initial maximum histogram bin containing the highest number of pixels exceeds a background threshold value;
  - f) verifying said background region analysis using region chrominance data;
  - g) labeling any background regions as such;
  - h) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - i) verifying said contone regions using region properties, wherein said contone regions are eliminated when a contone region's area is smaller than the square of one tenth of the page width;
  - j) analyzing said contone regions to identify text regions present within said contone regions;
  - k) analyzing said contone regions to identify background regions present in said contone regions;
  - l) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
  - m) repeating steps e-g until no further sub-regions are found; and
  - n) analyzing said contone regions and said contone sub-regions to identify pictorial contone regions and non-pictorial contone regions.

29. (new) An image segmentation method, said method comprising:
- a) obtaining pixel attribute data for a mixed-content image, said pixel attribute data comprising at least one of a luminance data, a chrominance data and a hue data;
  - b) downsampling said pixel data;
  - c) filtering said pixel data to remove noise;
  - d) computing a local discriminating feature, selected from the group consisting of standard deviation and spread, to identify a text region in said image, wherein a region is identified as text when said feature is above a local feature threshold value;
  - e) analyzing a luminance histogram of said image to identify a background region in said image, wherein a region is identified as background when an initial maximum histogram bin containing the highest number of pixels exceeds a background threshold value;
  - f) verifying said background region analysis using region chrominance data;
  - g) labeling any background regions as such;
  - h) analyzing areas in said image outside any of said background regions and outside any of said text regions to identify contone regions;
  - i) analyzing said contone regions to identify text regions present within said contone regions;
  - j) analyzing said contone regions to identify background regions present in said contone regions;
  - k) analyzing areas in said contone regions outside any of said background regions and outside any of said text regions to identify contone sub-regions;
  - l) repeating steps e-g until no further sub-regions are found; and
  - m) analyzing said contone regions and said contone sub-regions to identify pictorial contone regions and non-pictorial contone regions, wherein said analyzing to identify pictorial contone regions comprises eliminating the two histogram bins containing the highest number of pixels and analyzing the remaining bins for bi-modal distribution.